

**COOLING CHAMBER AND SYSTEM OF A COOLING CHAMBER WITH A  
MICROTOME**

**CROSS REFERENCE TO RELATED APPLICATIONS**

**[0001]** This application claims priority of the German patent application 103 46 996.6, filed October 7, 2003, which is incorporated by reference herein.

**FIELD OF THE INVENTION**

**[0002]** The invention concerns a cooling chamber for a microtome. Additionally the invention concerns a system of a cooling chamber with a microtome.

**BACKGROUND OF THE INVENTION**

**[0003]** The microtome with the designation Leica Ultracut UCT, on which the Leica FCS cooling chamber is mounted, has two illumination systems as standard equipment. Fluorescent lamps are mounted outside the chamber next to the objective of the stereomicroscope, and serve to illuminate the cut sections. The second illumination system is positioned, by means of light guides, directly beneath the knife. The bright gap produced by this illumination is helpful as the knife and specimen are brought close to one another.

**[0004]** The model MTX and MTXL microtome of the RMC company has an illumination system that is equipped similarly to the illumination system of the Leica company's microtome. Since the illumination of the fluorescent lamps is not sufficient, a fiber optic illumination system is offered as an accessory. Two goosenecks placed to the left and right of the knife are usual.

**[0005]** As already mentioned, illumination by means of fluorescent lamps has too little intensity to produce good visibility of the cut sections in the stereomicroscope. The illumination using a fiber optic system, on the other hand, can be brought very close to the knife and has sufficient intensity, but on the one hand it interferes with manipulation when the sections are removed from the knife, and on the other hand illumination with the fiber optic system causes ice crystals.

**[0006]** These ice crystals are produced because cooling chambers for ultramicrotomes are operated with liquid nitrogen. The liquid nitrogen produces nitrogen gas, which fills the chamber. Continuous formation of this gas causes it to flow steadily

out of the cooling chamber. This continuous flushing with dry gas prevents the entry of moist air and thus the formation of ice deposits, with no need for a cover on the chamber (which is open at the top).

**[0007]** If, however, objects such as the fiber optic system are inserted from outside into the chamber, they penetrate through the boundary layer between the cold nitrogen gas and the air at room temperature. These objects introduce heat into the cold region and cause turbulence, and the cold gas no longer flows out steadily. Turbulence at the boundary layer with the moist air results in the precipitation of small ice crystals, which then also settle on the knife and reduce the service life of a knife between cleanings.

#### SUMMARY OF THE INVENTION

**[0008]** It is therefore the object of the present invention to create a cooling chamber with which optimum illumination and reliable handling of cut sections is possible.

**[0009]** This object is achieved, according to the present invention, by a cooling chamber comprising an illumination system that emits light, a knife surrounded by the cooling chamber, wherein the knife defines a surface, and a stereomicroscope provided outside the cooling chamber for the observation of the surface of the knife, whereby the illumination system is arranged such that the emitted light is directed onto the surface of the knife in such a way that the light reflects from the surface toward the stereomicroscope.

**[0010]** It is a further object of the invention to create system a cooling chamber with a microtome or ultramicrotome with which optimum illumination and reliable handling of the cut sections is possible.

**[0011]** This object is achieved, according to the present invention, by a system of a cooling chamber with a microtome, comprising a knife defining a cutting edge, a sample holder, wherein the is knife and the sample holder are arranged in the cooling chamber and opposite to each other, a stereomicroscope positioned on the microtome wherein the stereomicroscope defines an optical axis, and the region of the cutting edge of the knife being observable with the stereomicroscope, and an illumination system

mounted in the cooling chamber emits light which is directed onto a surface of the knife in such a way that the light reflects from the surface toward the stereomicroscope.

**[0012]** The use of light-emitting diodes as the illumination system has the advantage that they emit only a small amount of heat and therefore cause no turbulence in the nitrogen gas. Light-emitting diodes have a small emission angle. Several light-emitting diodes can illuminate the knife in directed fashion, and result in a high intensity. Good visibility of the cut sections with the stereomicroscope is thus achieved at high magnifications. Depending on the arrangement and segmentation of the light-emitting diodes, the cut sections can be illuminated both laterally and perpendicularly. Operation of segments of the arrangement of light-emitting diodes makes possible, for example, oblique illumination or only frontal illumination. It has been found that light-emitting diodes are functional down to a temperature of approximately  $-160^{\circ}\text{C}$ . The arrangement according to the present invention of the light-emitting diodes in the cooling chamber ensures that the temperature does not fall below this value.

**[0013]** The illumination system provided in the cooling chamber is mounted so that the emitted light is directed onto a surface of the knife, and so that the light is reflected from the surface toward the optical system of the stereomicroscope. According to a further embodiment, the illumination system is arranged in the cooling chamber in such a way that the light of the illumination system reflects substantially parallel to the optical axis.

**[0014]** As already mentioned above, it is particularly advantageous if the illumination system is constructed from several light-emitting diodes (LEDs). Segments of the several LEDs can then be capable of being switched on and off individually in order to implement an oblique illumination of the surface of the knife.

**[0015]** According to a preferred embodiment, the illumination system is constructed from a first, a second, a third, a fourth, and a fifth LED. An oblique illumination of the surface of the knife can be implemented, for example, with the first and the second LED or also with the fourth and the fifth LED.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** Further advantages and advantageous embodiments of the invention are the subject matter of the Figures below and the descriptions thereof. In the individual Figures:

Figure 1 is a side view of an ultramicrotome with cooling chamber, parts of the cooling chamber being omitted in order to elucidate the association between the knife and sample holder;

Figure 2 is a cross section of the cooling chamber, side parts being omitted in order to elucidate the arrangement of the illumination system; and

Figure 3 shows the cooling chamber from above.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0017]** Figure 1 is a side view of a microtome or ultramicrotome **1** having a cooling chamber **10**. Parts of cooling chamber **10** are omitted in order to elucidate the association between at least one knife **2** and sample holder **4**. The at least one knife **2** is inserted into a knife holder **5**. Knife holder **5** is arranged with respect to a base-mounted illumination system **6** in such a way that exit opening **8** of base-mounted illumination system **6** is positioned below knife **2**, which is currently in the working position. The working position is defined by the fact that knife **2** is arranged opposite sample holder **4**. In the working position, thin sections can be produced with knife **2** from a sample **4a** that is clamped in sample holder **4**. Base-mounted illumination system **6** is used to achieve an optimum adjustment in the presetting operation between knife **2** and sample **4a**. An incident illumination system **13** for cooling chamber **10** is also provided on microtome **1**.

**[0018]** Microtome **1** is equipped with a stereomicroscope **12** that comprises an optical system **14**. Optical system **14** of stereomicroscope **12** defines an optical axis **11**. This configuration results in optimum contrast during alignment of knife **2** with respect to the surface of sample **4a** that is to be cut. The provision of base-mounted illumination system **6** means that cutting edge **16** of the respective knife **2** that is in the working position can be better detected and, if necessary, oriented with respect to sample **4a**.

**[0019]** Figure 2 shows, in addition to incident illumination system **13** that is shown in Figure 1 (but not shown in Figure 2), an illumination system **20** housed in cooling chamber **10**. Illumination system **20** comprises several LEDs. Cooling chamber **10** is cup-shaped and is closed off by a lid **22**. Lid **22** has in it an opening **24** that enables

access to interior **26** of cooling chamber **10**. In addition, lid **22** is equipped with a further cover **28** to allow the passage of light from incident illumination system **13** into cooling chamber **10**. Illumination system **20** is mounted just under or directly under lid **22** of cooling chamber **10**. Illumination system **20** is an arrangement of several LEDs whose light **20a** is directed onto knife **2**. Illumination system **20** is mounted in a region of cooling chamber **10** in which the temperature is sufficiently high for the operation of illumination system **20**. The temperature decreases sharply toward base **30** of cooling chamber **10**. Illumination system **20** is directed onto knife **2** in such a way that the direction of the reflection at a surface **2a** of knife **2** coincides with optical axis **11** of stereomicroscope **12**.

**[0020]** Figure 3 shows cooling chamber **10** from above. An arrangement of a first, second, third, fourth, and fifth LED **20<sub>1</sub>**, **20<sub>2</sub>**, **20<sub>3</sub>**, **20<sub>4</sub>**, and **20<sub>5</sub>** is shown here as an exemplary embodiment of illumination system **20**. An oblique illumination can be achieved when a segment of illumination system **20** is operated, e.g. by way of first and second LED **20<sub>1</sub>** and **20<sub>2</sub>** or fourth and fifth LED **20<sub>4</sub>** and **20<sub>5</sub>**. The number of LEDs and the segmentation of the individual LEDs is not predetermined, and can be adapted to the requisite illumination conditions. Knife **2** has a surface **2a** on which the cut sections that are produced come to rest. It is advantageous for the user if surface **2a** of knife **2**, on which the sections come to rest, reflects light **20a** of LEDs **20<sub>1</sub>**, **20<sub>2</sub>**, **20<sub>3</sub>**, **20<sub>4</sub>**, and **20<sub>5</sub>** into optical system **14** of stereomicroscope **12**. Sections of sample **4a** that are resting on this surface **2a** of knife **2** are readily detectable. LEDs **20<sub>1</sub>**, **20<sub>2</sub>**, **20<sub>3</sub>**, **20<sub>4</sub>**, and **20<sub>5</sub>** and their wiring **32** and control system **33** are located inside cooling chamber **10**. Disruption of the gas/air boundary layer is avoided.